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TECHNOGEOGRAPHY OR THE RELATION OF THE EARTH TO THE INDUSTRIES OF MANKIND.*

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Definition of the Earth in this Connection.

By technogeography is meant the study of the relationship between the earth and human arts and inventions.

Anthropogeography is the consideration of the earth in its broad connections with the whole science of man, including his body and his mind, his arts, languages, social structures, philosophies and religions. Of this broader subject there are many subdivisions; but at this time your attention will be directed to the activities of men as effected and affected by the earth, to which study the term technogeography is applied.† The arts of mankind have changed the face of nature, and some charming books have been written upon the subject of the earth as modified by human action.‡

*Annual address of the President of the Anthropological Society of Washington, delivered January 30, 1894.

† *Ethnogeography* would be the science of the relations of the earth and its forces to the creation of the several races or kindreds of mankind; *Glossogeography*, of the languages of mankind as effected or affected by the earth; *Mythogeography*, of the relation of the earth to mythology; *Esthogeography*, of the fine arts as born and nurtured by nature, and so on.

‡ George P. Marsh: *Man and Nature*, N. Y., 1864, Scribner. Arnold Guyot: *The Earth and Man*, Bost., 1865, Gould. But the father of this science is Karl Ritter, in *Die Erdkunde im Verhältnisse zur Natur und Geschichte des Menschen*, Berl., 1822-'59, 10 vols.

But now we are to trace out a few of the great industries of our race as they were provoked and developed by their terrestrial environment; in short, human actions as they were shaped and modified by the earth.

In this inquiry the earth as modifying human life includes the land surface down to the bottom of the deepest possible mine or artesian well or geological stratum; all the aqueous mass—that is, every drop of water in the seas and out of them, for there is no telling when any drop may enter the circle of human agencies and ownerships; the circumambient air, every gallon of that aerial ocean which swathes the world and vitalizes all living things, the common carrier of clouds and birds, of health and disease, of music and perfumes, of industry and commerce. As modifying human conduct, as subject of preëmption and monopoly, not only the masses just mentioned are included, but motions and powers, even gravity, mechanical properties, physical forces, chemical activities, vital phenomena of plants and animals, that may be covered by patents and their uses become a matter of legislation and diplomacy.

Definition of Human Industries.

The industries here discussed are chiefly the commonest trades and daily occupations of men, in which material substances and terrestrial forces are involved. However, as Mr. Spencer and other writers on dynamic anthropology well observe, even the most intellectual and spiritual activities of men have their operative side, their apparatus and sensible processes. The earth not only modifies the trades and crafts, but all human activities, however evoked.*

1. In the first place, I ask you to remember that every action in every industry, in every climate, and every status of culture involves five substantial elements: †

a. Raw materials in endless varieties and attributes.

b. Motive power of man, beast, fire, air, water, gas, hard substances, chemistry, electricity.

* The reader cannot afford to neglect a little book by Thomas Ewbank, entitled, "The World a Workshop; or, The Physical Relationship of Man to the Earth." N. Y., 1855, Appleton.

† These are in addition to the formal or intellectual cause, of Aristotle.

c. Tools and machinery, including both their manual or operative and their working parts and the mechanical powers involved.

d. Processes, simple, complex, and compound—that is, single motion for single function, many movements for simple function, many motions for many functions.

e. Products ready to supply desires or give satisfaction or to enter as material into new series of changes.

The progress of mankind means the greater and greater elaboration of these—more uses or functions for the same species of material furnished by the earth, more species of the earth's materials for each function or piece of work ; more uses for each form of power, and more forms of power involved in the same use ; more parts to the handle and working portion of the same tool, and more tools for the same operation ; more movements or forms of motion in the same process and a greater variety of processes to compass the very same result ; more elements or products of industry to gratify a single desire, and the creation of new and more exacting desires by the refinement of society.

2. I beg you to hold in mind, secondly, the fact that all voluntary human actions are carried on to satisfy wants or needs, bodily, mental, spiritual, social, beginning with the lowest animal cravings and ending with the highest aspirations of the most exalted men ; also you must remember that these needs have been developed and organized by a larger and larger acquaintance with the earth and its resources.

The order of arising of these wants, both in the child and in the race, have been for food, rest, shelter, clothing, defense. The order of intellectual wants was in the same lines. Each craving has grown from simplicity and monotony to variety and complexity, involving more activities in the same process, more and more varied mental processes in the same activity, ending with coöperative thinking of higher and higher order.*

3. Remember, thirdly, that these industries for gratifying desires may be grouped into the following classes as regards the earth, together constituting a cycle and each involving the five elements before named :

* Cf. Lester F. Ward, *Dynamic Sociology*, 1893, 2 vols.

a. Going to the earth for raw materials—fishing, hunting, gleanings, lumbering, mining. Some of these may be enlarged by cultivation and domestication in order to stimulate the generosity of the earth.

b. Carrying, hauling, transporting, in any stage of manipulation, using the powers furnished by nature.

c. Manufacturing, changing the physical, chemical, or vital form, or the size or shape, or combinations of materials for some useful end.

d. Exchange, barter, buying, selling, with all the handling that is involved. In this there is a rude mimicry of the correlation and conservation of energy.

e. Consumption, the storing and using up of the finished product, either to wear it out or to make it the raw material of another cycle of activities of the same kind. In brief, the sum of human industries is the arts of exploitation, cultivation, manufacture, transportation, commerce—extremely simple in primitive life, infinitely complicated and interlocked in civilization. The industries of men, from this point of view, are the transformation of terrestrial materials, by means of terrestrial forces, according to processes of which the earth set the earliest examples, and all this to gratify human desires.

The Earth as the Producer of Mankind.

The earth is the mother of all mankind. Out of her came they. Her traits, attributes, characteristics they have so thoroughly inherited and imbibed that, from any doctrinal point of view regarding the origin of the species, the earth may be said to have been created for men and men to have been created out of the earth. By her nurture and tuition they grow up and flourish, and folded in her bosom they sleep the sleep of death.

The idea of the earth-mother is in every cosmogony. Nothing is more beautiful in the range of mythology than the conception of Demeter with Persephone, impersonating the maternal earth, rejoicing in the perpetual return of her daughter in spring, and mourning over her departure in winter to Hades.*

* See also Hill, *Genetic Philosophy*, N. Y., 1893, Macmillan, and the teachings of Max Müller's school in the interpretation of Aryan mythology.

The human race is put into relation with all bodies through gravitation, with all mineral, vegetal, and animal substances through the laws of physics and chemistry; with the vegetal and the animal kingdom through the additional phenomena called life, and with all animals through mentation.*

The Earth as a Storehouse of Materials.

The earth is also a great warehouse of materials of infinite qualifications for gratifying human desires.

This is apparent enough to any one who reflects about it, but few persons think of the long ages during which these substances were being compounded and compacted. These materials are the foundation of all technique and all styles of technique—textile, plastic, graphic, glyphic, tonic, and landscape. For them the earth not only furnishes the raw stuffs, but the apparatus and different motives to different races.

We should not overlook the fact, however, that the greatest care of time has been bestowed on that thin pellicle of the earth called the soil, from which come our food, and that of our domestic animals, our clothing, our habitations, our vegetal and animal supplies, and even the sustenance of the marine products upon which we prey. I have not time in this place to speak of the labor bestowed by nature upon what Professor McGee calls "the veneer of brown loam," out of which the most of human activity has sprung.†

Before quitting the subject of the study of the earth as a warehouse the student ought not to overlook the varied characteristics of these resources. The qualities of things are the earth's, the grains and colors of the same stone, the elasticity and fibres of timber, the plasticity and temper of clays, the malleability and ductility of the same metals, and so on. So marked are these that in our higher civilizations we must have iron from half a dozen countries to conduct one of our complex establishments.

* See de Quatrefages, *L'Espèce humaine*, 12, Bib. Sc. Internat., Paris, 1877.

† Henry Balfour: *Evolution of Decorative Art*, London, 1893, Percival. W. H. Holmes: *Evolution of the Æsthetic*, Proc. A. A. A. S., x1, 239. W. J. McGee: *The Mississippi Old Field*, A. A. A. S., 1891. But especially Ruskin in "Modern Painters," and, indeed, in all his writings about art.

The very diversity of the same material from place to place has resulted in the production of the greatest possible variety of skill.

How quickly the lower races of men recognized these qualities and put them to use, not only discovering that stone is flaky and bois d'arc elastic, for instance, but that there are certain conditions under which these qualities exist more favorably than in others.

The Earth as a Reservoir of Forces.

The earth is also the reservoir of all locomotion and power useful to man.* Even the strength of his own limbs and back is derived from the food which she bestows. I do not speak of that, however, but of the substitutes therefor. She gives to the North American Indians the dog, to the South American the llama, to the people of the eastern continent the horse, ass, camel, elephant, and ox to convey them about and to carry or draw their loads.

The winds blow upon the sails and turn the mills, the waters set in motion the wheels and transport the freight. The steam is a still more versatile genius of power, and electricity just enters upon its mission. Coal, as a cheap source of energy, enables men to substitute for areas of raw material areas of manufacture and, indeed, to create areas of consumption.

The several kingdoms and forces of nature give rise to their several bodies of arts, each of which springs from the earth, and their investigation may be named as follows:

1. Physiotechny, of arts dependent on the physical forces of the earth.

2. Pyrotechny, of arts of creating and utilizing fire.

3. Anemotechny, of arts based on uses of the atmosphere.

4. Hydrotechny, of arts based on the uses of water.

5. Lithotechny, of arts based on uses of minerals and rocks.

6. Phytotechny, of arts based on uses of plants.

7. Zootechny, of arts based on uses of animals.

It would occupy too much space were I to elaborate in the most elementary manner the methods in which domestic animals,

* "A great factory or shop of power, with its rotary times and tides." Emerson, Letters, &c., 135, Bost., 1883.

wind, fire, water, elasticity of solids, elasticity of gases, explosives, chemical action, magnetism and electricity had enrolled themselves in the service of mankind merely to furnish power to do the work that in the simplest form is done by hand. Every one of them must have struck terror into the hearts of the first men. By being subdued they obeyed the principle that I have previously laid down of increasing their own usefulness and indispensableness by creating and complicating new wants.

The form of the globe, its coast lines, elevations and reliefs, the amount of sunshine, the properties and contents of the atmosphere, the varying temperatures, winds, rainfalls, the springs beneath the surface, the waterfalls on the surface also act as motives, if not as motive power to all apparatus and all the movements of men.* We cannot eliminate the heavenly bodies from this enumeration, since they furnished clocks and almanacs and compasses to primitive peoples, and longer voyages were undertaken by their guidance in the Pacific than were made two centuries later in the Atlantic by Columbus with the aid of the mariner's compass.

The Earth as a Teacher of Processes.

Exploitation and cultivation, manufacture, transportation, exchange, consumption, as I have previously said, together constitute the round through which commodities are conducted in the progress of industries. The proposition is that the earth was in the beginning and is now the teacher of these activities. There were quarriers, miners, lumberers, gleaners, and, some say, planters; there were fishermen, fowlers, trappers, and hunters before there was a *genus homo*. There were also manufacturers in clay, in textiles, and in animal substances before there were potters, weavers, and furriers; there were all sorts of moving material and carrying passengers and engineering of the simplest sort. It might be presumption to hint that there existed a sort of barter, but the exchange of care and food for the

* Gardiner G. Hubbard: Relations of Air and Water to Temperature and Life, Nat. Geog. Mag., Wash., 1894, vi, 112-124. N. B. Emerson: The Long Voyages of the Hawaiians, Honolulu, 1893. A. W. Greely, Internat. Pressure and Storm Charts, Signal Office, Wash., 1892.

honeyed secretions of the body going on between the ants and the aphidæ look very much like it.

The world is so full of technological processes brought about among her lower kingdoms that I should weary you in enumerating them. Stone-breaking, flaking, chipping, boring, and abrading have been going on always, by sand-blast, by water, by fire, by frost, by gravitation. Archæologists tell us that savages are very shrewd in selecting bowlders and other pieces of stone that have been blocked out and nearly finished by nature for their axes, hammers, and other tools.*

In tropical regions of both hemispheres where scanty clothing is needed certain species of trees weave their inner bark into an excellent cloth, the climax of which is the celebrated tapa of Polynesia. Furthermore, the fruits of vines and trees offer their hard outer shells for vessels and for other domestic purposes, for adornment of the persons, and as motives in art and handicraft.

Among the animals there is scarcely one that has not obtruded itself into the imaginations of men and stimulated the inventive faculty. The bears were the first cave-dwellers; the beavers are old-time lumberers; the foxes excavated earth before there were men; the squirrels hid away food for the future, and so did many birds, and the last named were also excellent architects and nest-builders; the hawks taught men to catch fish; the spiders and caterpillars to spin; the hornet to make paper, and the crayfish to work in clay.

2. The very genius of transportation and commerce also is taking commodities from places where they are superabundant and from ownerships where there is an excess over needs and placing them where they are wanted. It is a change of place to relieve excess and to supply demands. The savages had their changes of place and of ownership, constituting a primitive or elementary commerce, having all the characteristics of the modern; but I am now speaking of something that preceded even this. Nature had her great centers of superabounding material and took pains to convert this excess into supply against scarcity. She had devised her balance-wheels to effect uniformity of life and to preserve it against famine and failure. In illustration of this let me point out two or three examples:

* Consult the papers of J. D. McGuire in the American Anthropologist.

a. She stored up the excess of one season to supply the scarcity of another season of the year. Many examples of this could be cited. All over the earth bees gather honey from ephemeral plants that man cannot eat and store it away in enduring form to be used by man in time of need. In certain regions of California the piñon seeds grew so abundantly that the Indians could not gather them ; but the squirrels did lay them up in vast quantities, fed on them in winter, and themselves were eaten by the savages at a time when meat diet was most necessary, and gave to the Indians a lesson in economy and storage.

b. She used the excess of one locality to supply the dearth of another locality. In some places along the great lakes the wild rice (*Zizania aquatica*) covers thousands of acres and feeds millions of water fowl. These same creatures are the source of food for the Eskimo, who never saw a spear of grass nor ate a mouthful of vegetal diet. They are also wonderful teachers of the art of migration. Seeds of plants entered into this natural transportation through rivers and ocean currents, through winds and by the agency of birds, even of migratory birds, and set up in their progeny new centers of supply on distant shores.

c. But the most marvelous of all these commercial enterprises of nature is that in which she converts apparently inaccessible and unutilizable material into inexhaustible supplies for every industry of man. A wonderful example of this is found in the littoral feeding grounds. There is a bench of land under the sea skirting every shore and reaching under all estuaries. It is not deep. Indeed, it is the connecting link between the land and the profound sea. Upon this plateau the débris of the fertile lands and fresh waters are daily poured and myriads of the lower plants and animals are developed. Here are nourished cod, shad, herring, salmon, oysters, clams, and so on. The fish, after attaining maturity, actually swim up to men's doors to be captured ; also upon this feeding ground are nourished the sea mammals, which have been indispensable to the life and happiness of our northern aborigines. It is true that every useful plant is converted by nature out of material which men cannot use. Long before Texas cattle were bred in one place and driven hundreds of miles to market, nature reared fish and walrus

upon her enormous pasture-lands under the sea and drove them to market herself.

3. From one point of view the languages and literatures of men have been taught and suggested by the earth. Many words in all languages are imitations of the cries and sounds of nature. The motions and actions of her creations and creatures give rise to names for our common activities. By figures of speech the conduct of these beings furnishes the literary man and the moralist with means of graphic and pleasing description.*

Furthermore, every act is an expression of thought, and everything made by men is a testimony to the intellectual life of the man who made it. Even our most poetic and spirituelle conceptions find their counterparts in phenomena around us.

4. The earth has furnished man with examples of many forms of social life, from the absolute promiscuity of gregarious creatures to the monogamy for life among the eagles. The problems of society, clanship, government, and politics were working themselves out under the eyes of primitive man.†

5. In the forms of its creeds and its cults, humanity does not seem to be able to get away from earthly patterns. The Elysian fields, the Valhalla, the life that now is, reflected upon the life beyond, are all shaped after models familiar upon the earth. Likewise the cults of men, involving places of worship, social organization, times of meeting, festivals, and the like, necessarily depend upon climate and environment generally. There is a true sense in which religion is physiographic and in its lower forms entirely naturistic.

In her rôle as teacher, however, the earth always compels her pupil to make his own research and applications. I have heard it said of Bishop, the mind-reader, that he would, when blind-folded, find objects that had been secreted at a distance by sim-

* Consult Cushing, *Manual Concepts*, Am. Anthropol. Bushnell, Horace: *Moral Uses of dark Things*, N. Y., 1868, 8vo. Weale, J. M.: *Derivation of Sounds in Language from Noises made by Animals*, Rep. Brit. A. A. S., Lond., 1892-'3, 907. C. Lloyd Morgan: *Animal Life and Intelligence*. Sir Arthur Henry Helps: *Animals and their Masks*, Lond., 1883.

† Lubbock, *Ants, Bees, and Wasps*, N. Y., 1882, Int. Sc. Ser. On the Senses and Intelligence of animals, *ibid.*, vol. 65. Wood: *Our Insect Allies*, Lond., 1884, 238. C. V. Riley, Presidential Address, Biol. Soc., Wash., 1894. F. Houssa: *Industries of Animals*, Scribner, 1893.

ply holding the hand of the one who hid them. He relied upon the involuntary or unconscious resistance of the concealer to guide him. When the resistance ceased he knew he was going wrong. I have figured to myself the forces of the earth holding progressive peoples by the hand in the same manner. *She* knew where all the good things were concealed. They find them when she resists. When nature does not resist us she is leading us astray, when she unconsciously holds us back we follow to success in the lines of greatest pressure.

The Earth as a Whole an Organized Structure.

Indeed, whatever view my hearers may take of the creation of the earth, and of its resources, and of man, the earth must be looked upon as a thoroughly organized object. You may not believe in the old doctrine of the "Spirit of the world," the *Weltgeist* of Goethe, and still no living being seems to work with greater harmony of parts. An intelligent spirit seems to be present everywhere, whose conduct is always consistent, whose actions may be predicted for years in advance. Nay, more, this spirit seems to be endowed with like passions as we are and to act for the best interests of men's spirits, helping and cheering the wise, discouraging and demoralizing the negligent. The whole conduct of our globe is of such a character, all its activities and resources are so thoroughly one throughout, that in every respect we are justified in speaking of it as an organism, a being, a creature, a body of living forces, a congeries of intelligent resources. It is in this quasi-active sense that I wish to regard it now in relation to the elements and results of human trades and industries.

Little change has taken place in the globe since man stood first upon it, a naked and inexperienced being. The planet itself was at that time fixed in its orbit and the moon now shines upon the earth at night as it did upon the first man. The sun has, almost unchanged, been witness of all human history. The amount and movements of the atmosphere have not varied perceptibly, though the air may now be deteriorating and the soil wasting through human agencies. The minerals in the bowels of the earth, the genera of living plants and animals are older than man. They were here for his use before he was born.

Continental land masses, oceans, seas, and rivers have altered only a little since the *genus homo* came to dwell upon them.

This is an important series of facts in our study, because the other element of the problem will be an exceedingly variable quantity. The evolution of the earth was complete when man came to stand upon it. The evolution of human arts began where the evolution of the earth left off.

This subject of the whole earth directing human industry may be viewed from two different points—the technic side, or that in which the trades and invention come into prominence, and the physiographic side, or that in which the active forces of nature as determining the trades are more conspicuous. From either point of view there will be seen an orderly procedure, a movement as though some pilot held the helm. Regarded from the former, the genius of man of families, or races, of epochs, seems to be the active and only cause; regarded from the latter, the puissant earth seems to have been more the leader, mover, suggester.*

The Culture Areas of the Earth.

Besides this general view of the earth as an organized series of materials and forces, it is necessary also to study it in parts, to anatomize it, as the zoölogists would say. The most cursory glance reveals the fact that there are certain well established worlds within this world. This earth, which seems to be an oblate spheroid, all parts of which are approachable from the rest and their functions almost interchangeable one with another, is made up of great isolated parts or patches, which may be denominated culture or intentional areas, *Oikoumenai* of Aristotle. Each one of the areas has a climate of its own, waters and lands of its own, plants and minerals and animals; indeed, a physiography of its own; so that when a group of human beings have, in the fortunes of existence, found themselves in one of these

* Upon the antiquity of the general plan of earth structure consult J. W. Powell: *The Laws of Hydraulic Degradation*, Science, N. Y., 1888, xii, 229-233; also his *Colorado River* volume. C. E. Dutton, *Monograph*, ii, U. S. Geol. Survey, 72, 219, and *An. Rep.*, ii, 60, 61. C. D. Walcott: *Geologic Time*, J. of Geol., Chicago, 1893, i, 239-676.

The author has developed the inventor's side of the question in a series of papers on *Primitive Inventors and their Patents*.

spaces they have been irresistibly developed into a culture and trades and industries of their own. This was the centrifugal stage or the evolution of industries. It was just as though they had cut themselves off from the rest of their species and gone to inhabit another world.*

The forces acting to create these culture areas were, first of all, earth forces, the same that were at work to build the earth. After the general plan of the entire structure was laid down, the fitting and furnishing of the various apartments was a matter of local appropriation of these forces. Solar heat, moisture, terrestrial forms and movements horizontally and vertically coöperated in each area to stamp upon it the type of its life. The result in each instance was to create a series of conditions suitable for some lives and not for others, suitable for man in one stage of his culture journey and not in others. In regard to the capability of meeting man's necessities, the regions of which we are speaking may be thus characterized :

1. Areas of discouragement, too cold, too hot, too wet, too dry, too elevated, malarious, infested with noxious insects or beasts, too thickly forested. By and by these very regions might become centers of greatest activity.

2. Areas of monotony. Upon this point Schrader uses the following comparison :

"Life commenced in the water, where the changes of light, heat, pressure, food, and occupation were very slight, attained

* "I take leave to use the Greek term *oikoumenē*, which denotes any considerable portion of the earth's surface whose parts intercommunicate, but which is isolated from the rest of the world." Payne, *Hist. of America*, Oxford, 1892, Clarendon pr., i, 27, quoting Aristotle, *De Mundo*, iii: The order of development of the *oikoumenē* was, 1, the creation of small, isolated areas; 2, the commingling of areas; 3, the establishment of one area, the world embracing *oikoumenē*. These culture areas are called "Geographical provinces" by Bastian and "Areas of characterization" by de Quatrefages. See D. G. Brinton, *Races and Peoples*, N. Y., 1890, Hodges, 94, quoting: Haughton, *Lect. on Phys. Geog.*, Lond., 1880, 273; —Bastian, *Zur Lehre von den geog. Provinzen*, Berlin, 1886; —De Quatrefages, *Hist. Gen. d. Races Humaines*, Paris, 1889, 333; —Achelis, *Die Entwicklung der Modern Ethnologie*, Berl., 1889, 65; —Darwin, *Descent of Man*, 169. See also Le Bon, *The Evolution of Civilization and the Arts*, *Pop. Sc. Month.*, N. Y., 1892-'93, xlii, 342-349. F. W. Parker, *The Relation of Geography to History*, *Nat. Geog. Mag.*, Wash., v, 125-131.

its complete development on the land, in an element more delicate and more mobile, in the midst of reactions more multiple and more varied."

This same rule applies to the lands themselves. Those in which men occupied a homogeneous environment were like the sea, and the people were little differentiated. The arctic regions in their marine mammals and semi-aquatic men furnish a good example of this class.

But in the equatorial regions of the globe there occurs much of the monotony of environment which characterizes the circum-polar region. In the latter man exhausts himself in his efforts for subsistence; in the former he does not develop because nature supplies his few wants and at the same time overwhelms the work of his hands; but in Australia all the unfavorable conditions of human existence are exaggerated. Isolation, aridity, want of indentations and relief, absence of useful plants or animals; these negative conditions are certainly, of all in the world, least favorable to man.

Schrader follows the plan of establishing anthropological zones, but tidewater, Piedmont, and mountain areas are also important.*

3. Areas of two elements, two elevations, two seasons, two occupations, two wants. This will be exemplified further on.

4. Areas of many elements, with variety of climate, scenery, sources of material supply, and means of communication, stimulating the appropriation of nature's largess.

As regards the creation of races of men, these regions were ethnic areas. Respecting arts and industries, they certainly were technic areas, and therefore they were most important elements in the present study.

In the most primitive life exploiting, transportation, manufacture, barter, and consumption in each culture area extended

* Rev. Mens. de l'Ecole d'Anthrop., iii, 205-208, Paris, 1893, Alcan; also McGee, *The Earth as the Home of Man*, Saturday Lecture, 1893.

"Bananas and plantains are rapid growers, producing fruit in a twelve month. A constant supply is kept up during the year. The fruit is eaten green or ripe, raw, boiled, roasted, and fried. Humboldt says that on a given area it produces 44 times more nutriment than the potato; 133 times more than wheat. It reproduces perennially and abundantly and may be called an 'institution for the encouragement of laziness.'"—Squier, *Mosquito Coast*, 109, Lond., 1857.

over little space, used only a few materials, changed their form only a little, were in the hands of a few persons, and their products were consumed on the spot. A Zuni woman walks five miles to the mesa for clay, carries it home on her back, makes it into pottery, decorates and burns it, and then wears it out in cooking, water-carrying, or storing food. She is at once miner, common carrier, potter, artist, cook, and purveyor. Her culture area does not embrace more than 100 square miles.

Even now many of these separate culture areas, in spite of the mixing of people in the historic past, may still be traced. From the North American continent the savage has been nearly moved, but scholarship is able to lay down the home sites of all the historic families; the habitations of their various stocks are marked out geographically.

On the extreme northern limit of America there is a fringe of icy coast. You may commence to trace it in the northeastern corner of Greenland. The whole shore of this land mass forms a part of that area, down to Cape Farewell and up to Smith's sound. Resuming your journey about the southern limit of Labrador, you are to explore Baffin land, all about Hudson bay, among the islands of northern Canada, past the mouth of Mackenzie river all the way to Bering strait. The Arctic shores of both continents above and below these straits as far west as Lapland, in Norway, must be included, and the Alaskan coast as far down as Mount St. Elias. This is the Arctic, the inter-hemispheric world. . . .

Immediately in contact with this hyperborean oikoumenē is the birch-bark region, extending in both hemispheres. The house, the boat, the snowshoe frame, the vessels for food and water and for cookery, the lumber for all arts, and the food for much of the game are hence derived. It is the birch-bark country in space, just as we speak of the stone age, the bronze age, the steel age, in time. In early culture they did not ship birch wood and bark, but birch art sprung from birch environment. Geography was the mother of the arts. . . .

The land-locked inlets of America's northwest coast, extending for more than a thousand miles, being a safe and easy mode of communication between Thlingit, Haida, Tsimshian, Nutchkans, and Coast Salish tribes, not only was there much borrow-

ing of myth and speech and commingling of blood, but arts were interchanged and an incipient commerce engendered.

The great interior basin of the United States is arid, but abounds in excellent seed-producing plants, and here the people were bread-eaters and all the term implies. The plains of the great West were the abode of innumerable buffalo, and there the tribes, regardless of ethnic differences, were tall meat-eaters, dwelling in hide teepees, clothing themselves in skins, and practicing a hundred arts with reference to this one animal. On the east coast of North America were the clam, oyster, turtle, abundance of mackerel, shad and herring, plentiful supply of wild fowl and mammals and fertile lowlands and diversities of wood for their implements. These varied conditions produced on the whole the finest Indians north of Mexico. The same careful scrutiny of the Mexican plateau, the Orinoco, or the Amazon drainage, of the three culture elevations of Peru, of the river systems of Africa, of the island groups of the Indo-Pacific, would, if we had time to go over them, show us that the common trades and daily toil of the people run in grooves like a train of cars. Each people had ransacked its own environment and got the best out of it that their grade of culture was capable of extracting.

It is not necessary to continue the enumeration of these technic areas of the earth. It may be truly said that each distinct zoölogical or botanical region was capable of developing a distinct body of arts. And, *per contra*, if there be found a people in possession of industries that are unique, then the region must be ransacked for the environment and resources that endowed and patronized these industries. The art and the craft are of the region. No people are to be held responsible for the development of any of nature's gifts if nature has never bestowed them.

In America, when it was discovered, the technic regions were not equally advanced in the culture of their inhabitants. In the valley of Mexico and in Central America and on the Pacific coast of the Andes were the highest arts. The western continent, as a whole, was not the best fitted by nature for man's advancement. The mammals would none of them yield their milk and there were no draught or pack animals except the dog in the north and the llamas in the south. All the arts of the new world were the works of men's hands; consequently the whole

area of culture skill was little elevated compared with that of the eastern continents. But the Mexican and the Peruvian body of industries occupied the most artificial centers.*

The Earth as a Single Culture Area.

No sooner had the varied riches of different areas begun to manifest themselves to one another than human feet took up the march which has given the whole earth to the whole species, and promises to make of it, by and by, a single neighborhood. In short, the earth developed in isolated peoples a separate set of industries. With your permission I shall call it the centrifugal or outward movement.

Next, it brought these separate cultures together as a higher composite organization of industry, and tends at last to make all men dependent upon the entire earth. This you will let me call the centripetal movement.

The centrifugal movements were the actions of savages and barbarous peoples. The centripetal movements were toward civilization. The movements toward widening the *oikoumenai* were:

1. Intra-areal, or inside the geographic province to enlarge it.
2. Inter-areal, between small contiguous provinces.
3. Inter-regional, overstepping great natural barriers.
4. The march of aggressive campaigns.
5. Inter-continental, the beginnings of universal conquest.
6. Inter-hemispheric, the periods of great discoveries.
7. Universal.†

* The reasons for this are worked out in Payne's "History of America," volume i, with consummate skill.

† Indeed it would not be difficult to give examples of some of these in their order. The experience of every family and clan is expressed in the following schedule:

1. Family or Gentile expansion: "Behold now the place where we dwell with thee is too straight for us." 2 Kings, vi, 1.
2. Algonquian, Carib, Malayan expansion.
3. Ancient Mexicans and Peruvians; all the Mediterranean races.
4. Egypt, Assyria, Phœnicia, Rome, Germany, Russia.
5. Jenghis Khan, Alexander, Napoleon.
6. Columbus, Vasco da Gama, Drake.
7. The present attitude of the Caucasian race.

The primitive occupation of different culture areas on the earth prepared the way for the diversification of the ways and means of gratifying human desires. This centrifugal man developed the culture areas and their arts. The more advanced centripetal man brought the arts together and thus provided for their universal distribution, elaboration, and perfection.

Barter and long journeys for subsistence, cultivation of plants and domestication of animals, the use of machinery, and the storage of food were not unknown to pre-Columbian Americans. In one grave near Chillicothe, Ohio, were found copper from northern Michigan, obsidian from Yellowstone park, mica from North Carolina, pyrula shells from the Gulf of Mexico.

Ivory hunting and other natural causes set the African negroes on the move before the days of recorded history, so that there is no longer a negro race. Their original neighborhood is not known; their languages are better means of classification than themselves; their arts are hopelessly mixed.*

In studying the migrations which might have led Mongoloid peoples to America, the escape from the regions of an ever-vanishing food supply in the rear and the pursuit of an inviting food supply in front played a prominent part. Two hundred years ago and more the upper Pacific, the Bering sea, and the plains of the great West contained far the largest storages of human subsistence in the world. The fish, the seacow, the Arctic mammals, the caribou, the buffalo, in a certain sense, peopled America.†

In the Indian ocean and the Pacific, six hundred years ago, the Polynesian race suddenly became the Norsemen of that area. In their improved canoes, with sails and outriggers, they set out from Tonga and visited Easter islands, on the east; Madagascar, on the west; New Zealand, on the south, and Hawaii, on the north, each journey being not far from two thousand miles from home. No other motive was assigned but to follow the leadings of nature to behold and enjoy more of the earth.‡

* The capture of women and slaves and other social causes urged on these movements, but these will be considered in another paper.

† Consult Payne's *History of America* for the importance of the food quest; also Morgan's *Essay on Migration* in Beach's *Indian Miscellany*.

‡ N. B. Emerson: *The long Voyages of the Ancient Hawaiians*, p. 34, *Hawaiian Hist. Soc.*, Honolulu, 1893.

In this same Malayo-Polynesian area, especially in the region extending from Australia to Indo-China, there is a curious mixing of the regional question with that of race. Here dwell Negroes, Malays, Polynesians, and Australians; but the material out of which things are made, the implements with which they are made, and the products of industrial arts are clearly of the soil, and there is great confusion of industry and race, undergoing the process of transformation from segregation to unification.

Racial peculiarities overlap the natural elements of industry and the technogeographer and the ethnogeographer are merged into the ethnotechnologist.

The Mediterranean sea remained a barrier until many diverse civilizations were developed on its African, Asiatic, and European shores. It was at first a means of dividing peoples of the same race until they had elaborated their several contributions to industrial processes.

The second stage of industrial development had begun when the first column of Aryan history began to be written.

Of early Caucasian and Mongolian culture only a few hints can be given. In prehistoric times precisely the same law was in force which the American continent revealed to the eyes of the discoverers; but another state of things was in operation there in historic times, namely, the working out of the higher law of commerce and artificiality of life, in the operation of which the genius of man rises superior to natural barriers and exigencies and turns whole continents or the whole earth into one organized culture area or *oikoumenē*.

No one can tell the region that gave to man the cereals of Europe. It is said that rice is a contribution from southeastern Asia, but whence wheat, rye, barley, millet, oats? Fruits, like apples, plums, quinces, peaches, belong to the same category. The date may be accredited to Africa and the grape to many lands. But there is no account of our race at a time when the genius of invention was being developed through them in their separate *oikoumenai*. The historian was too late on the field to record the gathering of them in a wild state.

Likewise the domestic animals. The dog offered his services as a hunter and a beast of burden, the cat as the enemy of vermin; the cow, horse, ass, elephant, sheep, goat, camel, llama were

furnished by nature to enhance the arts of food, shelter, clothing, manufacture, transportation, and to set an example of industry ; but of the transition there is no record. The second stage of industrial development had begun when the second volume of Aryan history was about to be written.

The Earth in Relation to the Higher Artificial Life.

In primitive life culture areas were chiefly the regions where abounded the raw materials. They were in fact areas of natural exigencies. But in higher civilization the arts have usurped the prerogative of nature and created artificial culture areas. Plants have been made to grow and animals to thrive thousands of miles from their original home. Materials of all sorts are carried to manufacturing centers to be made up into forms for commerce and consumption. These are artificial technic areas, whose geography is an essential study in political economy.

For example, the Muskoki Indian woman used to go to the fields, gather the wild hemp, carry it home, soak it, hackle it, spin it, weave it, and then use it up on the spot. But on that very ground now grows the cotton, a foreign plant, raised by one man, ginned by another, hauled on wagons to railroads, thence carried to the sea and across it to great manufacturing towns, where it is hauled and spun and woven, and hauled and shipped and sold and sold until the product may be seen in every portion of the habitable globe. The geography of this one staple in its multiform transformations, brought about by the gradual appropriation of all the forces of the earth and then its movements until at last it has been caught in the current of every terrestrial wind and followed every world-encompassing oceanic stream, would exemplify what I am trying to say about the coming of the globe to be one united *oikoumenē*.

In all this the race has grown, not independent of the earth, but more dependent upon it. Artificial and domesticated supplies of material are as much from the earth as the wildest. Men in devising tools and machinery and engines to do the work of their hands have had to go to their mother for them. They use other forces than their own, but they are still forces furnished by the earth. They have multiplied invention upon

invention, but every one of them is a device for using a great loan already in hand for the purpose of raising a larger one.*

At one time men simply breathed the air and moved about and clothed and sheltered themselves at its behest. It came gradually into human history somewhat as follows :

1. As a terrestrial force, chemical, mechanical, geological, and as supporter of life.

2. In the production of climate and temperatures and as instigator of clothing and habitation.

3. As distributor of seeds, insects, birds, &c.

4. As promoter of fire, draft, and the like.

5. In the distribution of pollen, microbes, and other minute organisms.

6. The mover of sails advancing from the use of local breezes to that of the trades.

7. The mover of wheels and machinery.

8. As an elastic force in mechanics.

9. In aërial transportation.

10. In science and religion.†

In this way fire wrought for man, first making his house, then as a master of his childhood, and last of all acting the part of maid of all work. The order might be summed up as follows :

1. Earth-builder, moving the strata vertically.

2. Fierce weapon against beasts, men, microbes.

3. Preserver of substances, food, and other material.

4. In cooking.

5. Artificial heater for the dwelling.

6. For illumination.

7. In mechanic arts.

8. In agriculture.

9. In locomotion.

10. In generating higher forces ; in literature and myth.

After the same fashion it would be possible to enumerate the varied services of water :

1. Geological worker in vapor, frost, snow, rain, dew, and as carrier of materials.

* For the history of this power in nature, first to create the earth and then man, and then to bring the earth under the dominion of man, see Powell's lectures on biotic and anthropic evolution, *Am. Anthropologist*.

† In this last connection read Ruskin's "The Queen of the Air."

2. In springs and wells and water works.
3. Carrier for man in rivers and open waters.
4. In artificial ponds for fish and irrigation.
5. In canals and enclosed basins.
6. In the undershot wheel.
7. In the overshot and the turbine.
8. In the form of steam.
9. In hydraulic mining.
10. In comprehensive service, as at Buffalo and in other cities.

The minerals, plants, and animals used at first by man could be counted on your fingers.

The growth of culture has increased the number of useful species as a whole, the functions of each one, the amount of labor bestowed upon each individual element, the depth of mines, the amount of waste, the distances traveled and the velocity of locomotion, the difference of weight between the passenger or freight and the weight of the train or the ship.

In this partnership between man and the earth the progress of culture has been from naturalism to artificialism; from exploitation to cultivation and domestication; from mere muscular power to more subtle physical force of man, of beast, of water, of air, of fire, of electricity; from tools to machinery; from simplest imitative processes to highly complex processes, involving many materials and motive powers and inventions; from short journeys to long journeys; from mere barter to world-embracing commerce; from monotonous and monorganic food and clothing, shelter and furniture, mental and social appliances to forms as complex and varied as the imagination can conceive. And when the supply gives out, it is not the earth that fails, but it is the comprehension and the skill of men. The race that used to drag out centuries in learning one letter of the industrial alphabet, leaving its offspring to repeat the process, now catches new secrets in every hour and perpetuates the understanding of them for posterity.

In that long journey from natural to artificial life the resources by which industries have been fostered underwent varied fortunes. In another place I have characterized the periods of human land or earth holding:

1. The period of earth building and soil building—man absent.

2. The period of harmless dependence. The earth took care of man, who did little to waste the earth.

3. Man attacked the earth with firebrands, burning forests and creating wastes. The style of agriculture called *coomry* in India had here its incipency.

4. The age of mining began, the bow and the harpoon were invented and the wholesale destruction of animal life set in.

5. The commencement of plowing—that is, of the era of wasting the soil and sending it to the bottom of the waters.

6. The age of subduing the natural forces, the commencement of machinery.

7. The beginning of economy.

8. The age of artificial production and propagation.*

In this evolutionary process some of the materials and plants and animals were:

1. Destroyed irrevocably.

2. Converted into other forms, domesticated, and preserved.

3. Abandoned and more useful materials took their places.†

The fate of natural forces and resources may be summed up as follows:

1. The sun's heating, illuminating, and chemical power unlimited and inexhaustible.

2. Consequently, wind and water power and electromotion beyond the capability of man to exhaust.

3. The mineral kingdom—most easily wasted, air vitiated, water contaminated, fuel exhausted, soil washed away, and its most delicate ingredients used up forever—receives the most anxious thought of legislators. For the wasted soil man finds a partial compensation in irrigation and in the subaqueous feeding grounds. Chemistry is making long strides to render the species independent of the fertile portions of the soil.

4. The fate of the vegetal kingdom is easy to predict. The useful plants will be preserved and multiplied; those that are useless and noxious will be treated with indifference or exterminated.

* "The Land Problem," Lectures Brooklyn Ethical Assoc., N. Y., 1892, 119.

† W J McGee: *The Mississippi Old Fields*, A. A. A. S., 1891. G. P. Marsh: *The earth modified by human action*, in "Man and Nature," N. Y., 1864, Scribners.

nated. For a long time, however, the natural supply will be more than sufficient.*

In the three elements of food plants, fibre plants, and forest production the world seems stocked for all time.

5. Animal life must become altogether subservient to man or at least innocuous. Capabilities of variation and multiplication are unlimited both on land and in the sea. Indeed, the marine life of the great estuaries and coastal plane will restore to man a portion of his losses through denudation, impoverishment of the soil, and through sewage, and species of animals now useless will be yoked to service.

You can see how these transitions from discrete and independent culture areas to one, all embracing *oikoumenē*, must modify the politics and the thought of the world. Little did the Bongo smith care about ships or trains, about treaties or tariffs. His materials were at hand, his motive power was his good right arm, his tools were the hardest rocks he could find, his transportation was a short haul on human backs, his commerce was barter, his goods were consumed near by.

While the higher life of industry was being elaborated by the commingling of diverse occupations, the peoples were commingling under other motives. Old, natural barriers were swept away, it is true, but new, artificial, political barriers were set up, often making war across industrial boundaries and interrupting the proper flow of the true culture. The state boundaries of the United States are excellent examples. Indeed, the bloody wars that have cursed the earth have been for the most part for the possession of its material resources by peoples having false artificial limits.

The higher life of industry, the true artificial life, by the commingling of the arts that were severally developed in culture areas, found itself at war with the ethnic life, which has formed itself on entirely different principles.†

The end is hastening, however, when the false and unnatural political boundaries will be swept away or ignored, the non-

* See Riley on the enormous amount of honey that goes to waste through want of bees to gather it.—Presidential Address, *ut supra*. (quoting Meade on the best fruits).

† Gardiner G. Hubbard: *Geographic Progress of Civilization*, Nat. Geog. Mag., vi, 1, Wash., 1894.

progressive races extinguished or driven to the suburbs, the play of world-wide action left unincumbered, the flow of world-embracing commerce unimpeded, and every desire of man will be gratified. The development of this higher law of technogeography is left for another occasion.

In conclusion, let me call your attention to the beneficent effect of this alliance between man's arts and the earth. The law seems to be one of mutual blessing and mutual cursing. Poor farmers, poor fishermen, poor miners occupy the worst land or fishing grounds or mines. Each mutually degrades and impoverishes the other. The reverse is true of the shrewd and industrious.

Now, what is fact of these single workers was true of tribes, hordes, races, peoples.

The right progress looks forward to a time when the whole earth will have been exploited, every pernicious plant and animal and man or tribe of men removed, and all that is good domesticated ; when the powers of nature will all be harnessed or enslaved ; when distance and time will offer no impediment to commerce ; when it will be as easy to put production and consumption in friendly union at the springing up of desire as it was for the primitive man or woman. The earth will be subdued by men who will say to the mountains, " Be ye removed and be ye cast into the sea, and it shall be done, and the desert shall blossom as the rose."*

* Already the flooding of the Sahara, the digging of the Suez canal, the interoceanic highway between North America and South America admonish us of the coming end. In primitive times the animals found the tracks across the mountains ; the hunters followed the trails ; the trains of pack animals followed the hunters, and by and by came wagon roads and railroads. The savage formerly walked across the water-sheds, then he made portages, then men dug canals, and finally they tunneled the mountains and united all the seas.